Subject: .... Year: .... Month: .... Day: .... ( )

تمرین شماره ۱ فیزیک

۱-

$$\frac{k(q_a-q_b)q_c}{\frac{d^2}{4}} = k \times \frac{110\times 30\times 10^{-12}}{\frac{1}{4}} \simeq 79.1$$

۲-

$$\left|F_{-q,q}\right|_x = k\frac{q^2}{4a^2} \xrightarrow[\text{جذب}]{\text{تعیین الاتجاه}} F_{-q,q} = \frac{-kq^2}{4a^2}x$$

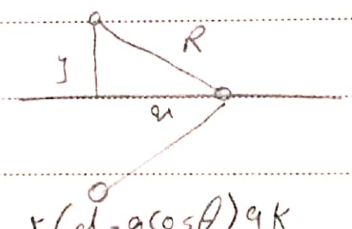
$$E_{\text{حلقه}} = \int_0^{2\pi R}\frac{a}{\sqrt{a^2+R^2}}\times k\frac{dq}{a^2+R^2} = \int_0^{2\pi R}\frac{a}{\sqrt{a^2+R^2}}\times k\frac{\lambda\, dx}{a^2+R^2} = \int_0^{2\pi R}\frac{a}{\sqrt{a^2+R^2}}\, k\frac{2\lambda_0 q\, dx}{a^2+R^2}$$

$$= k\frac{a\,2\lambda_0 q}{(a^2+R^2)^{\frac{3}{2}}}\,x\Big|_0^{2\pi R} = k\frac{4\pi a\lambda_0 R q}{(a^2+R^2)^{\frac{3}{2}}} \xrightarrow{F=Eq} |F| = k\frac{4\pi a\lambda_0 R q^2}{(a^2+R^2)^{\frac{3}{2}}}$$

$$\xrightarrow[\text{دفع}]{\text{هم علامت}} k\frac{4\pi a\lambda_0 R q^2}{(a^2+R^2)^{\frac{3}{2}}} \xrightarrow{F_E+F_q} \left(k\frac{4\pi a\lambda_0 R q^2}{(a^2+R^2)^{\frac{3}{2}}} - \frac{kq^2}{4a^2}\right)x$$

$$F_y, E_y = 0$$

۳-



$$\frac{2x}{\sqrt{x^2+y^2}}\;\frac{kq}{x^2+y^2}$$

$$\frac{2(d-a\cos\theta)qk}{(a^2+d^2-2ad\cos\theta)^{\frac{3}{2}}} \xrightarrow{\frac{d}{dx}} \frac{2kq\left((a^2+d^2-2ad\cos\theta)^{\frac{3}{2}} - 3(d-a\cos\theta)^2(a^2-2ad\cos\theta+a\ldots)^{\frac{1}{2}}\right)}{(a^2+d^2-2ad\cos\theta)^3}$$

$$=0 \longrightarrow (a^2+d^2-2ad\cos\theta)^{\frac{3}{2}} = 3(d-a\cos\theta)^2\underbrace{(a^2+d^2-2ad\cos\theta)^{\frac{1}{2}}}_{} \longrightarrow$$

مصدر و نقطه عرض است و معادل ساده کردن

$$a^2+d^2-2ad\cos\theta = 3d^2+3a^2\cos^2\theta-6ad\cos\theta \longrightarrow 2d^2-(4a\cos\theta)d+a^2(3\cos^2\theta-1)=0$$

$$\longrightarrow \Delta = 16a^2\cos^2\theta - 8a^2(3\cos^2\theta-1) \longrightarrow d = \frac{4a\cos\theta \pm 2\sqrt{2}\,a\sin\theta}{4} = a\cos\theta \pm \frac{\sqrt{2}}{2}a\sin\theta$$

TANDIS

۴ـ با اعمال مرزی زوایای:

$$E_x = \int_0^{\frac{\pi}{2}} \sin\theta \, \frac{\sigma_0 R^2 d\theta}{4\pi\varepsilon_0} = -\frac{\sigma_0 R^2}{4\pi\varepsilon_0} \cos\theta \Big|_0^{\frac{\pi}{2}} = \frac{\sigma_0 R^2}{4\pi\varepsilon_0}$$

E_y به روش مشابه:

$$E_y = \frac{\sigma_0 R^2}{4\pi\varepsilon_0}$$

سپس با اعمال مرزی شعاعی:

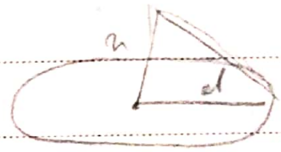
$$E_x = -\int_a^b \frac{\sigma_0}{4\pi\varepsilon_0} R^2 = \frac{-\sigma_0}{4\pi\varepsilon_0} \int_a^b R^2 \longrightarrow \frac{-\sigma_0}{12\pi\varepsilon_0} R^3 \Big|_a^b =$$

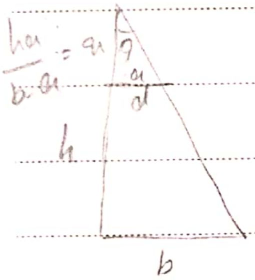
$$\frac{-\sigma_0}{12\pi\varepsilon_0} (b^3 - a^3)$$

E_y به روش مشابه:

$$E_y = \frac{-\sigma_0}{12\pi\varepsilon_0} (b^3 - a^3) \longrightarrow E = \frac{-\sigma_0}{12\pi\varepsilon_0} (b^3 - a^3)(\hat{x} + \hat{y})$$

۵ـ





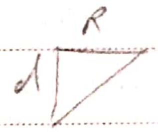
$$\frac{x}{x+h} = \frac{a}{b} \rightarrow bx = xa + ha \Rightarrow x = \frac{ha}{b-a}$$

$$\int_0^{h} \frac{k\sigma \, ds \, x \, d}{x^2 + d^2} \times \frac{x}{\sqrt{x^2 + d^2}} \qquad x = \frac{dh}{b-a}$$

$$\int_a^b \frac{\sigma d^2 \frac{h}{b-a}}{2\varepsilon_0 \left(d^2 \left(1 + \frac{h^2}{(b-a)^2}\right)\right)^{\frac{3}{2}}} \longrightarrow \frac{\sigma x d}{2\varepsilon_0 (x^2 + d^2)^{\frac{3}{2}}} \quad \frac{\sigma h}{2\varepsilon_0 (b-a) \underbrace{\left(1 + \frac{h^2}{(b-a)^2}\right)}_{\frac{(b-a)^2 + h^2}{(b-a)^2}}^{\frac{3}{2}}} \int_a^b \frac{1}{a} =$$

$$\frac{\sigma (b-a)^2 h}{2\varepsilon_0 \left((b-a)^2 + h^2\right)^{\frac{3}{2}}} \times \ln \frac{b}{a}$$

۶ـ



$$\int_0^{2\pi R} \frac{d}{\sqrt{d^2 + R^2}} \times \frac{k\sigma \, dx}{d^2 + R^2} = \frac{2\pi R k \sigma d}{(d^2 + R^2)^{\frac{3}{2}}}$$

$$\int_0^R \frac{2\pi \sqrt{R^2 - x^2} \, k\sigma x}{R^3} = \frac{2\pi k\sigma}{R^3} \left(-\frac{1}{3} (R^2 - x^2)^{\frac{3}{2}}\right) \Big|_0^R = \frac{-2\pi k\sigma}{3} \longrightarrow$$

$$\frac{-2\pi\sigma}{12\pi\varepsilon_0} = \frac{-\sigma}{6\varepsilon_0} (\hat{z})$$

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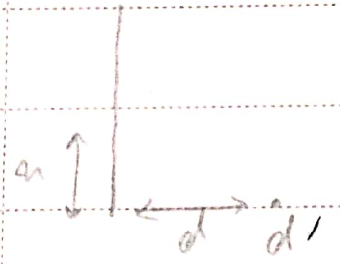

$$E_x = \int_0^\infty \frac{d}{\sqrt{x^2+d^2}} \times \frac{k\lambda_1 dx}{d^2+x^2} = dk\lambda_1 \left(\frac{x^3\left(\frac{1}{d^2}+\frac{1}{x^2}\right)}{(d^2+x^2)^{\frac{3}{2}}} \right)\Bigg|_0^\infty$$

$$= \frac{k\lambda_1}{d}$$

$$E_y = \int_0^\infty \frac{x}{\sqrt{x^2+d^2}} \times \frac{k\lambda_1 dx}{d^2+x^2} = k\lambda_1 \left(\frac{1}{\sqrt{x^2+d^2}}\right)\Bigg|_0^\infty = \frac{-k\lambda_1}{d}$$

$$F_y = \int_{x_1}^{x_2} \frac{k\lambda_1\lambda_0 x\,dx}{x} = \frac{-\lambda_1\lambda_2}{4\pi\varepsilon_0}(x_2-x_1)(\hat{y})$$

۱-۵

$$F_{(x_1)} = \frac{\lambda_1\lambda_2}{4\pi\varepsilon_0}(x_2-x_1)\hat{x} \xrightarrow{F_{d_0} d_{x1}} \frac{\lambda_1\lambda_2}{4\pi\varepsilon_0}(x_2-x_1)(\hat{x}-\hat{y})$$: بطور مشابه F_x